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10/620,002	07/14/2003	Dinesh Chopra	2269-4373.2US (00-0036.02)	7481
24247	7590	01/04/2007	EXAMINER	
TRASK BRITT P.O. BOX 2550 SALT LAKE CITY, UT 84110			UMEZ ERONINI, LYNETTE T	
			ART UNIT	PAPER NUMBER
			1765	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/04/2007	PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

## Office Action Summary

Application No.

10/620,002

Applicant(s)

CHOPRA ET AL.

Examiner

Lynette T. Umez-Eronini

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 04 December 2006.  
2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.  
3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-25 is/are pending in the application.  
4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.  
5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.  
6) ☒ Claim(s) 1-25 is/are rejected.  
7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.  
8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.  
10) ☒ The drawing(s) filed on 7/14/2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).  
11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)  
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)  
3) ☒ Information Disclosure Statement(s) (PTO/SB/08)  
Paper No(s)/Mail Date 12/4/2006.  
4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.  
5) ☐ Notice of Informal Patent Application  
6) ☐ Other: \_\_\_\_\_.

## **DETAILED ACTION**

### ***Request for Continued Examination***

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114 to reconsider Applicants' Remarks in Amendment, filed 11/20/2006. Applicant's submission filed on 12/4/2006 has been entered.

### ***Claim Rejections - 35 USC § 102***

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1-11 and 15-19 are rejected under 35 U.S.C. 102(e) as being anticipated by Hudson (US 5,972,792).

Hudson teaches a method of chemical-mechanical planarization of a substrate on a fixed abrasive polishing pad in which a planarizing solution is dispensed onto the pad (Abstract). The planarizing solution may be used to planarized titanium and

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aluminum on a tungsten plug, a titanium nitride barrier layer (column 4, lines 1-25) and copper (column 4, lines 50-52); has a pH of between 3.0 and 10.0 (column 4, lines 53-54); includes an oxidant such as ferric nitrate, hydrogen peroxide, potassium iodate, and bromine (column 4, lines 35-37 and 53-56); and has a mixture of 0.1%-1.0% benzotriazole, 0.1%-5.0% nitric acid, and deionized water (column 4, lines 56-65). The above read on,

A slurry for use in polishing a copper structure of a semiconductor device, the slurry being substantially free of abrasives.

Since Hudson uses a composition that is substantially free of abrasives as claimed by applicants, then using Hudson's slurry in the same manner as claimed in the present invention would inherently result in the slurry being formulated to substantially concurrently polish copper and a barrier material with the barrier material being removed at substantially the same rate as or at a slower rate than copper is removed, **in claim 1;**

being formulated to oxidize copper at substantially the same rate as or at a faster rate than the barrier material is oxidized, **in claim 3;**

wherein, in the slurry, the barrier material and copper have substantially the same oxidation energies, **in claim 4;**

wherein, in the slurry, the barrier material has an oxidation energy of about 0.25 V more to about 0.20 V less than an oxidation energy of copper in said slurry, **in claim 5;**

wherein, in the slurry, a rate of removal of the barrier material is up to about ten times slower than a rate of removal of copper, **in claim 6**;

wherein, in the slurry, a rate of removal of the barrier material is about two to about four times slower than a rate of removal of copper, **in claim 7**;

wherein the slurry is formulated to remove copper and the barrier material without substantially dissolving the barrier material that underlies remaining portions of copper, **in claim 8**;

wherein the slurry comprises at least one oxidizer, at least one pH control agent, and at least one inhibitor, **in claim 9**;

wherein the at least one oxidizer comprises at least one of an ammonium compound, a nitrate compound, and an amine compound, **in claim 10**; and

wherein the at least one oxidizer comprises at least one of hydrogen peroxide, potassium iodate, potassium permanganate, ammonium persulfate, ammonium molybdate, ferric nitrate, nitric acid, potassium nitrate, and ammonia, **in claim 11**.

Hudson also teaches planarizing with a silica-ceria fixed abrasive polishing pad (column 4, lines 38-39), which reads on the slurry being formulated for use with a fixed-abrasive polishing pad comprising at least one of aluminum dioxide, titanium dioxide, silicon dioxide, and cerium dioxide, **in claim 2**.

The said above encompasses,

wherein the slurry has a pH of about 2 to about 6, **in claim 15**;

wherein the at least one inhibitor comprises about 0.05% to about 2% of the weight of said slurry, **in claim 18**; and

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wherein the at least one inhibitor comprises about 0.05 to about 0.2% of the weight of said slurry, **in claim 19.**

The said above also reads on,

wherein the at least one inhibitor comprises at least one of an azole, an amine, and a ring compound, **in claim 16;** and

wherein the at least one inhibitor comprises at least one of benzotriazole (BTA), mercaptobenzothiazole, tolytriazole, methylamine, diethylamine, pyridine, quinoline, dicyclohexamine nitrate, potassium silicate, ammonium borate, ammonium phosphate, and potassium dichromate, **in claim 17.**

#### ***Claim Rejections - 35 USC § 103***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to

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consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 12-14 and 21-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hudson (US '792) as applied to claim 1 above, and further in view of Nakazato et al. (US 4,459,216).

Hudson differs in failing to teach at least one pH control agent as recited in claim 14; and to specify the percent by weight of the oxidizer as recited in claims 12-13 and 23-24 and the complexing agent as recited in claims 21-22 and the temperature as recited in claim 25.

Nakazato teaches a chemical dissolving solution that is used in chemical polishing of metals such as copper. The chemical dissolving solution comprises hydrogen peroxide, an inorganic acid such as sulfuric, phosphoric, and nitric acid and an aromatic compound (Abstract; column 1, lines 5-15 and 28-33; and column 3, lines 12-24). The chemical dissolving solution includes 5g/l – 100 g/l (~0.1 to 10 %) of hydrogen and 100 g/l – 300 g/l of inorganic acid for polishing copper (column 3, lines 34-41) and can be used at a temperature of 10° - 80°C (column 3, lines 56-58). Nakazato also discloses a reference, which teaches a chemical polishing solution for copper, which comprises 0.5-30 % (w/w) sulfuric acid, 5-60% (w/w) hydrogen peroxide, and at least 0.1% (w/w) of an amine such as benzotriazole is used (column 1, lines 43-52).

Since the Nakazato reference is relied upon to teach an abrasive free solution comprising the specific concentration of oxidizer and complexing agent and operating

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temperature, which are known, then it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Hudson by using Nakazato's concentration of oxidizer and complexing agent as well as temperature for the purpose of providing a chemical dissolving solution having good stability, a long life, and capability of producing a lustrous metal surface for use in chemical polishing (column 1, lines 5-6 and column 2, lines 33-37).

7. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hudson (US '792) as applied to claim 1 above, and further in view of Suzuki et al. (US 5,885,334).

Hudson differs in failing to teach at least one complexing agent comprising at least one of glycine, ammonium citrate, ammonium phosphate, and ammonium acetate.

Suzuki teaches a polishing composition, which does not contain abrasive particles (column 6, lines 12-14). Suzuki also teaches the addition of a chelator and other additives such as glycine (same as applicants' complexing agent) can be added to the composition in order to give the composition additional properties. The addition of a chelator to the polishing composition is effective since metallic residue adhering to the polishing surface can be reduced (column 7, lines 14-28).

Since Suzuki illustrates a complexing agent is known, then it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Hudson by employing a chelator (same as applicants' complexing agent) as taught in the Suzuki reference for the purpose of reducing metallic residue adhering to the polishing surface (Suzuki, column 7, lines 23-26).



***Response to Arguments***

8. Applicants' arguments filed 6/5/2006 have been fully considered but they are not persuasive. Applicants traverse the rejection of claims 1-11 and 15-19 under 35 § U.S.C. 102(e) as being anticipated by Hudson (US 5,912,792) and claim 20 over Hudson (US '792) in view of Suzuki et al. (US 5,885,334).

Applicants traverse the rejection of claims 1-11 and 15-19 under 35 § U.S.C. 102(e) as being anticipated by Hudson (US 5,912,792). Applicants argue Hudson does not expressly or inherently describe that any slurry disclosed therein is formulated to substantially concurrently polish copper and a barrier material, with the barrier material being removed at substantially the same rate as or at a slower rate than copper is removed. Applicants argue Hudson neither expressly nor inherently describe each and every element of Claim 1, under 35 U.S.C. § 102(a), therefore Claims 2-11 and 15-19, which depend from Claim 1, are allowable. Applicants further argue Hudson neither expressly nor inherently describes,

a slurry that is formulated to oxidize copper at substantially the same rate or at a faster rate than a barrier material is oxidized, in Claim 3;

a slurry in which copper and a barrier material have substantially the same oxidation energies, in Claim 4;

a slurry in which a barrier material has an oxidation energy of about 0.25 V more to about 0.20 V less than an oxidation energy of copper, in Claim 5;

a slurry in which a rate of removal of a barrier material is up to about ten times slower than a rate or removal of copper, in Claim 6;

a slurry in which a rate of removal of a barrier material is about two to about four times slower than a rate of removal of copper, in Claim 7; and

a slurry that is formulated to remove copper and a barrier material without substantially dissolving barrier material that underlies remaining portions of copper, Claim 8.

Applicants' arguments are acknowledged, but are unpersuasive because Hudson teaches a planarizing solution may be used to a titanium nitride barrier layer (column 4, lines 1-25) and copper (column 4, lines 50-52); has a pH of between 3.0 and 10.0 (column 4, lines 53-54); includes an oxidant such as ferric nitrate, hydrogen peroxide, potassium iodate, and bromine (column 4, lines 35-37 and 53-56); and has a mixture of 0.1%-1.0% benzotriazole, 0.1%-5.0% nitric acid, and deionized water (column 4, lines 56-65). The above read on,

A slurry for use in polishing a copper structure of a semiconductor device, the slurry being substantially free of abrasives.

Since Hudson uses a composition that is substantially free of abrasives as claimed by applicants, then using Hudson's slurry in the same manner as claimed in the present invention would inherently result in

the slurry being formulated to substantially concurrently polish copper and a barrier material with the barrier material being removed at substantially the same rate as or at a slower rate than copper is removed, in claim 1;

the slurry being formulated to oxidize copper at substantially the same rate as or at a faster rate than the barrier material is oxidized, in claim 3;

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the slurry, the barrier material and copper have substantially the same oxidation energies, in claim 4;

the slurry, the barrier material has an oxidation energy of about 0.25 V more to about 0.20 V less than an oxidation energy of copper in said slurry, in claim 5;

the slurry, a rate of removal of the barrier material is up to about ten times slower than a rate of removal of copper, in claim 6;

the slurry, a rate of removal of the barrier material is about two to about four times slower than a rate of removal of copper, in claim 7; and

the slurry is formulated to remove copper and the barrier material without substantially dissolving the barrier material that underlies remaining portions of copper, in claim 8. NOTE: The rejection of claims 1-11 and 15-19 were made under "35 U.S.C. §102(e)" and not under 35 U.S.C. §102(a) as indicated by Applicants. However, the same response above for arguments presented for Claim 1 is applicable here.

Applicants traverse the rejection of claims 1-11 and 15-19 under 35 U.S.C. 102(e) as being anticipated by Hudson (US 5,912,792). Applicants argue Hudson does not expressly or inherently describe that any slurry disclosed therein is formulated to substantially concurrently polish copper and a barrier material, with the barrier material being removed at substantially the same rate as or at a slower rate than copper is removed. Applicants argue Hudson neither expressly nor inherently describe each and every element of Claim 1, under 35 U.S.C. § 102(a), therefore Claims 2-11 and 15-19, which depend from Claim 1, are allowable. Applicants further argue Hudson neither expressly nor inherently describes,

a slurry that is formulated to oxidize copper at substantially the same rate or at a faster rate than a barrier material is oxidized, in Claim 3;

a slurry in which copper and a barrier material have substantially the same oxidation energies, in Claim 4;

a slurry in which a barrier material has an oxidation energy of about 0.25 V more to about 0.20 V less than an oxidation energy of copper, in Claim 5;

a slurry in which a rate of removal of a barrier material is up to about ten times slower than a rate of removal of copper, in Claim 6;

a slurry in which a rate of removal of a barrier material is about two to about four times slower than a rate of removal of copper, in Claim 7; and

a slurry that is formulated to remove copper and a barrier material without substantially dissolving barrier material that underlies remaining portions of copper, Claim 8.

Applicants' arguments are acknowledged, but are unpersuasive because Hudson teaches a planarizing solution may be used to a titanium nitride barrier layer (column 4, lines 1-25) and copper (column 4, lines 50-52); has a pH of between 3.0 and 10.0 (column 4, lines 53-54); includes an oxidant such as ferric nitrate, hydrogen peroxide, potassium iodate, and bromine (column 4, lines 35-37 and 53-56); and has a mixture of 0.1%-1.0% benzotriazole, 0.1%-5.0% nitric acid, and deionized water (column 4, lines 56-65). The above read on,

A slurry for use in polishing a copper structure of a semiconductor device, the slurry being substantially free of abrasives.

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Since Hudson uses a composition that is substantially free of abrasives as claimed by applicants, then using Hudson's slurry in the same manner as claimed in the present invention would inherently result in

the slurry being formulated to substantially concurrently polish copper and a barrier material with the barrier material being removed at substantially the same rate as or at a slower rate than copper is removed, **in claim 1**;

the slurry being formulated to oxidize copper at substantially the same rate as or at a faster rate than the barrier material is oxidized, **in claim 3**;

the slurry, the barrier material and copper have substantially the same oxidation energies, **in claim 4**;

the slurry, the barrier material has an oxidation energy of about 0.25 V more to about 0.20 V less than an oxidation energy of copper in said slurry, **in claim 5**;

the slurry, a rate of removal of the barrier material is up to about ten times slower than a rate of removal of copper, **in claim 6**;

the slurry, a rate of removal of the barrier material is about two to about four times slower than a rate of removal of copper, **in claim 7**; and

the slurry is formulated to remove copper and the barrier material without substantially dissolving the barrier material that underlies remaining portions of copper, **in claim 8**. NOTE: The rejection of claims 1-11 and 15-19 were made under "35 U.S.C. §102(e)" and not under 35 U.S.C. §102(a) as indicated by Applicants. However, the same response above for arguments presented for Claim 1 is applicable here.

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Applicants traverse the rejection of Claims 12-14 and 21-25 under 35 U.S.C. §102(a) over Hudson (US '792) in view of Nakazato et al. (US 4,459,216) and argue the Claims are allowable, among other reasons, for depending directly or indirectly from Claim 1, which is allowable. The same response above for arguments presented for Claim 1 is applicable here.

As to claims 12-14 and 21-25, Applicants further argue Hudson teaches away from dissolving conductive material while oxidizing and polishing the same and Nakazato teaching a chemical dissolving solution having a good dissolving capacity for various kinds of metals is insufficient to overcome the fact that Hudson teaches away from the asserted combination. Hence, one would not be motivated to combine these references.

Applicants' arguments are acknowledged but are unpersuasive because the feature of dissolving conductive material while oxidizing and polishing the same is not required by the claimed invention. Applicants' arguments are also unpersuasive because the Nakazato reference is relied upon to cure Hudson's deficiencies by teaching an abrasive free solution comprising the specific concentration of oxidizer and complexing agent and operating temperature.

In response to Applicants' argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in

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the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, the reason for combining Hudson and Nakazato is to cure Hudson's deficiencies, in which the Nakazato reference is relied upon to teach an abrasive free solution comprising the specific concentration of oxidizer and complexing agent and operating temperature, which are known. Hence, it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Hudson by using Nakazato's concentration of oxidizer and complexing agent as well as temperature for the purpose of providing a chemical dissolving solution having good stability, a long life, and capability of producing a lustrous metal surface for use in chemical polishing (Nakazato, column 1, lines 5-6 and column 2, lines 33-37).

Applicants traverse the rejection of Claim 20 under 35 U.S.C. §103(a) over Hudson (US '792) in view of Suzuki et al. (US 5,588,334) and argue Claim 20 is allowable, among other reasons, for depending directly or indirectly from Claim 1, which is allowable. The same response above for arguments presented for Claim 1 is applicable here.

### **Conclusion**

9. This is a continuation of applicant's earlier Application No. 10/620002. All claims are drawn to the same invention claimed in the earlier application and could have been finally rejected on the grounds and art of record in the next Office action if they had been entered in the earlier application. Accordingly, **THIS ACTION IS MADE FINAL**

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even though it is a first action in this case. See MPEP § 706.07(b). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no, however, event will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynette T. Umez-Eronini whose telephone number is 571-272-1470. The examiner is normally unavailable on the First Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should



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you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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December 24, 2006

  
**GREGORY MILLS**  
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